Claims

What is claimed is:

1. An optoelectronic device comprising at least two spatially separate optical components formed on a single semiconductor substrate, each optical component including an active region, and a passive waveguide formed over the substrate and optically butt coupling the two components.

2. The device according to claim 1 wherein the active regions comprise multi-quantum well layers.

3. The device according to claim 1 comprising at least three optical components of different types.

4. The device according to claim 3 wherein the device comprises a laser, a modulator, and an optical amplifier.

5. The device according to claim 1 wherein each component includes a cladding layer on either side of the active region, and further comprising a cladding layer on either side of the passive waveguide.

6. The device according to claim 2 wherein the muli-quantum layers comprise InGaAsP.

7. The device according to claim 5 wherein each component further comprises a separate confinement layer on either side of the active region.

8 The device according to claim 1 further comprising a stop-etch layer formed over the substrate.

9. The device according to claim 8 wherein the stop-etch layer comprises InAlAs or GaInAlAs.

10. The device according to claim 1 wherein the passive waveguide comprises an identical composition between the components.

11. An optoelectronic device comprising:

at least three spatially separate optical components including a laser, modulator, and optical amplifier formed on a single substrate, each optical component comprising a multi-quantum well layer comprising InGaAsP sandwiched between cladding layers and separate confinement layers;

a passive waveguide formed over the substrate so as to form butt joints with the multi-quantum well layers and optically connect the components, the waveguide having an identical composition between the components comprising InGaAsP; and

a stop-etch layer comprising InAlAs or GaInAlAs formed over the substrate.

12. A method of forming an optoelectronic device comprising the steps of:

forming a plurality of epitaxial semiconductor layers on essentially the entire surface of a semiconductor substrate, the layers including at least one layer of an active material;

selectively etching the layers to form spatially separate structures including the active material; and

forming at least one passive waveguide layer in the etched areas so as to provide optical butt coupling between the active material of the separate structures.

13. The method according to claim 12 further comprising, prior to forming the active material, forming an etch-stop layer over the substrate, and selectively etching the epitaxial layers down to the etch-stop layer.

14. The method according to claim 13 wherein the etch-stop layer comprises InAlAs or GaInAlAs.

15. The method according to claim 12 wherein a plurality of layers including the passive waveguide layer are sequentially formed in the etched areas.

16. The method according to claim 12 wherein the active material comprises InGaAsP, and the passive waveguide comprises InGaAsP.

17. The method according to claim 12 wherein, prior to forming the passive waveguide, a separate plurality of epitaxial layers is formed for each type of optical component on the substrate.

18. The method according to claim 15 wherein the plurality of layers formed in the etched areas includes cladding layers.

19. The method according to claim 12 wherein the spatially separate structures are formed into at least a laser, modulator, and optical amplifier.

20. A method of forming an optoelectronic device including at least a laser, modulator, and optical amplifier on a single substrate comprising the steps of:

forming an etch-stop layer comprising InAlAs or GaInAlAs on a surface of the substrate;

separately forming a plurality of epitaxial layers over the substrate for each of the laser, modulator, and amplifier, the plurality of layers including multi-quantum active layers comprising InGaAsP;

selectively etching the plurality of epitaxial layers down to the etch-stop layer to form spatially separate structures;

sequentially forming a first cladding layer comprising InP, a passive waveguide layer comprising InGaAsP, and a second cladding layer comprising InP in the etched areas so as to form butt joints between the active layers and passive waveguide layer; and

forming the spatially separate structures into the laser, modulator, and optical amplifier.